

THE ZONE 2014
ZONAR'S ANNUAL CONFERENCE

Carrier Safety Management
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SAFETY for the LONG HAUL

MOTOR CARRIER SAFETY ASSOCIATES

SAFETY FOR THE LONG HAUL; LARGE TRUCK CRASH RISK, CAUSATION, & PREVENTION

Chapters:

1. Introduction & Overview
2. The Science of Safety
3. Driver Risk
4. Driver Error
5. Driver Fatigue
6. 4-Wheelers
7. Vehicle Design & Technologies
8. Roadway & Traffic Environment
9. Focus: Selected Crash Types
10. Carrier Safety Management
11. Special Topics in Carrier Operations
12. Regulation, Enforcement, & Compliance
13. Beyond Compliance

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Info at www.safetyforthelonghaul.com

TODAY'S TOPICS

- Crash Risk & Causation
- Safety Management Functions & Priorities
- Driver Selection
- Driver Evaluation
- Behavior-Based Safety
- Driver Retention
- Operational Risk Avoidance
- "Big 3" Crash Types

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Crash Risk & Causation

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MULTIPLE INTERACTING FACTORS

Environmental (e.g.; weather)

Temporary Personal (e.g.; hours driving, sleep the night before)

Enduring Personal (e.g.; health, physical skill, personality)

Environmental (e.g.; roadway)

Other Drivers and Traffic

Vehicle (e.g.; brakes, tires)

"RISK-CAUSE" MODEL

1. Factors affecting the **risk** of a crash
2. Driver errors & other failures **precipitating** crashes

RISK FACTORS → **PROXIMAL** → **CRASH**

Driver: personality, medical, fatigue, anger, using cell phone, etc.

Vehicle: brakes, equipment, etc.

Roadway: traffic density, roadway type, work zones, surface condition, visibility, etc.

LARGE TRUCK CRASH CAUSATION STUDY CRITICAL REASONS

LTCSS Critical Reason Categories	Examples	%
Truck Driver Physical Failure	• Asleep-at-the-wheel • Heart attack • Other physical impairment	6%
Truck Driver Recognition Failure	• Inattention • Distraction (internal or external) • Inadequate surveillance ("Looked But Did Not See")	16%
Truck Driver Decision Error	• Too fast for conditions • Following too closely • Misjudgment or false assumption	24%
Truck Driver Response Execution Error	• Overcompensation • "Sloppy" maneuver	3%
Truck Vehicle Failure	• Brake failure • Tire failure • Cargo shift	6%
Roadway/ Environment Affecting Truck	• Road signs/signals missing • Road design • Weather and/or slick roads	1%
OTHER DRIVER/VEHICLE "AT-FAULT"		45%

Note: A handwritten note in blue ink says "Most Addressable by Regulations & Roadside Inspections" with arrows pointing to the 16%, 24%, and 6% categories.

U.S. DOT EXPERT PANEL CLASSIFICATION OF ROADSIDE VIOLATIONS

Relevance to Crashes	%
Potential single, immediate cause	10%
Potential single, eventual cause	31%
Potential contributing cause	38%
Unlikely to contribute	9%
Little or no relevance	9%
Total:	100%


Source: FHWA OMC. Risk-based evaluation of CMV roadside violations: process and results. FHWA-MCRT-99-005, 1999.

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Commercial vehicle safety is multifaceted, and no function is more multifaceted than carrier safety management.

First sentence, Chapter 10



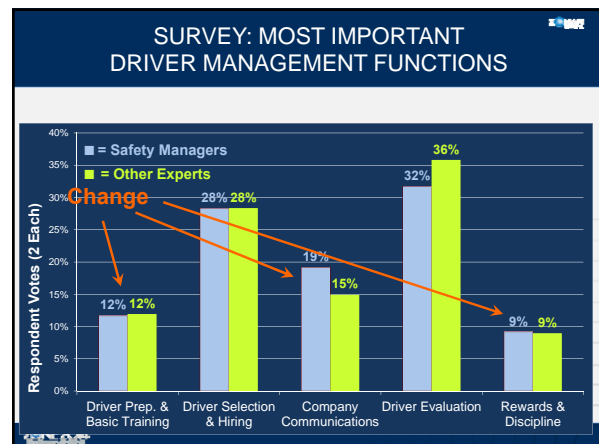
SAFETY for the LONG HAUL

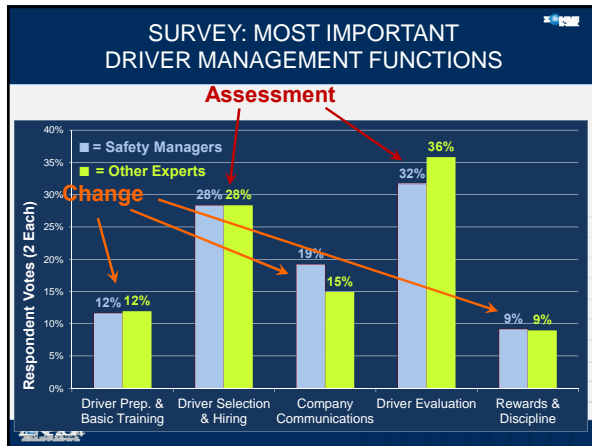
MOTOR CARRIER SAFETY ASSOCIATES

CARRIER SAFETY MANAGER FUNCTIONS

Functions:

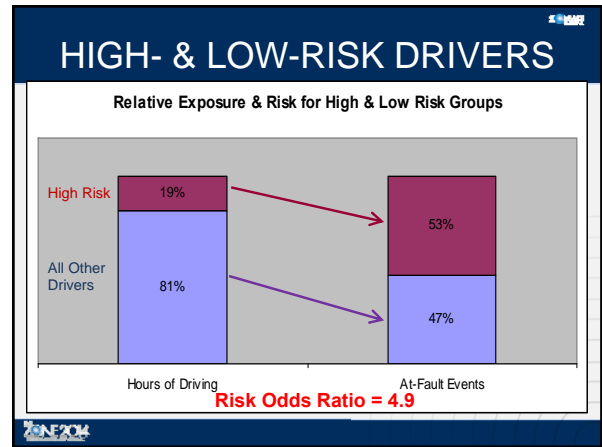
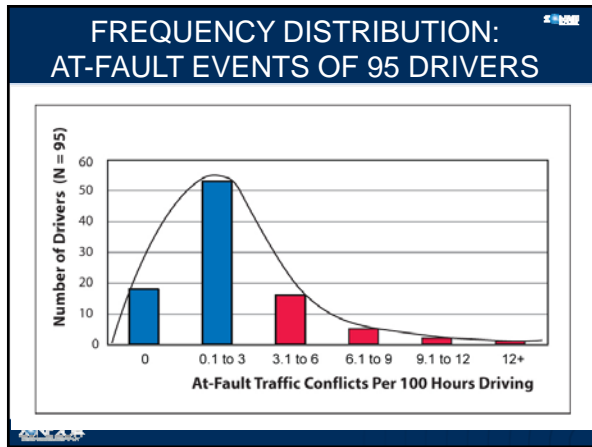
- Driver selection
- **Training**
- Evaluation
- **Behavioral management; e.g., rewards & discipline**
- Driver health management
- **Ensure compliance**
- Vehicle maintenance
- **Select and manage safety technologies**
- Minimize operational risk.



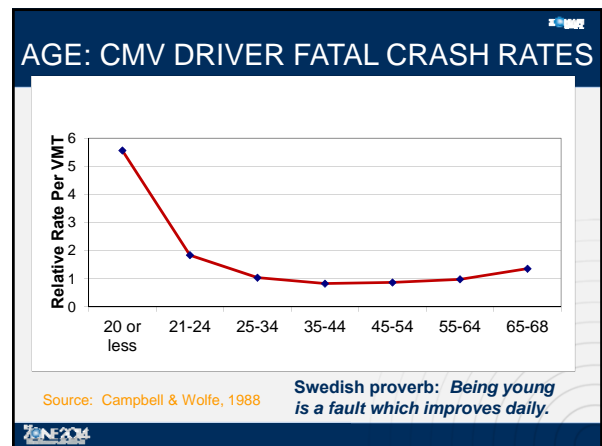
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FACTORS UNDERLYING ENDURING DRIVER RISK

- Age
- Physical & Medical Condition
- Personality
- Behavioral history





DYNAMIC PHYSICAL SKILLS RELATED TO DRIVING

- ❖ Perceptual
- ❖ Cognitive (Mental)
- ❖ Psychomotor; e.g., reaction time
- ❖ *Little effect on driving safety except for extreme deficiencies!*

MEDICAL CONDITIONS

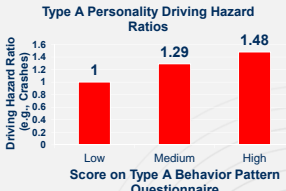
- ❖ Potential Consequences:
 - ❖ Degraded driving
 - ❖ Catastrophic failure (~3% in LTCCS)
 - ❖ Absenteeism & early retirement
- ❖ Notable Conditions:
 - ❖ **Sleep apnea & other sleep disorders**
 - ❖ **Cardiovascular illness**
 - ❖ **Obesity**
 - ❖ Diabetes
 - ❖ Epilepsy


PERSONALITY: BEHAVIORAL CONSISTENCY OVER TIME & SITUATIONS

- **Impulsivity/risk-taking**
- **Sensation-seeking**
- **Angry/hostile personality**
- **“Type A” aggressive personality**
- **Conscientiousness**
- **Emotional stability**
- **Agreeableness**

Type A Personality Driving Hazard Ratios



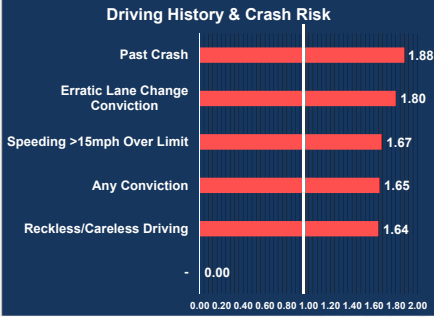
Score on Type A Behavior Pattern Questionnaire	Driving Hazard Ratio (e.g., Crashes)
Low	1
Medium	1.29
High	1.48




BEHAVIORAL HISTORY

- Driving Experience
- Company Tenure
- **Driving History***
- Non-Driving Behavioral History

Driving History & Crash Risk



Driving History Factor	Crash Risk Ratio
Past Crash	1.88
Erratic Lane Change Conviction	1.80
Speeding >15mph Over Limit	1.67
Any Conviction	1.65
Reckless/Careless Driving	1.64
-	0.00



CRIMINALITY & DRIVING SAFETY

- ❖ Leonard Evans: Non-driving criminality is associated with **≥2X** crash risk.
- ❖ Monash University (Australia) review: Positive associations:
 - ❖ General negative behavior & risky driving behavior
 - ❖ Criminal behavior & traffic offenses
 - ❖ Criminal history & risky behavior contributing to crashes.




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DRIVER EVALUATION METHODS

- Continuous tracking of crashes, incidents, & violations
- Onboard safety monitoring (e.g., speed, hard-braking)
- In-depth crash/incident investigations
- “Ride-along” observations of driving
- External surveillance of driving
- “How’s My Driving” placards



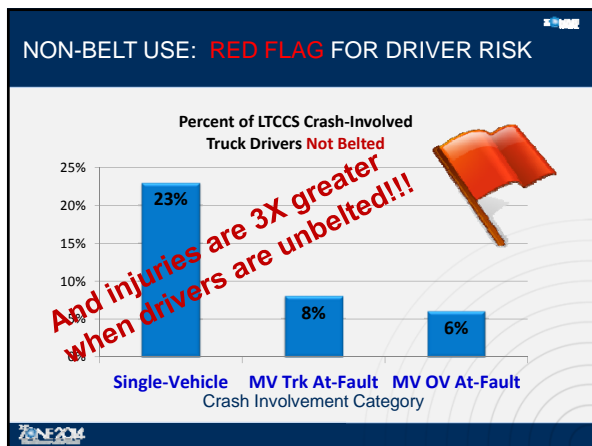
BEHAVIORAL “RED FLAGS”

In selecting, evaluating, & scheduling drivers, beware of two “red flags” or risk indicators:

- **Single-vehicle crash involvements**
- **Non-use of safety belts**

LTCCS: SINGLE-VEHICLE VS. MULTI-VEHICLE CRASHES

- **Single-** vs. all **multi-vehicle** involvements:
 - **32X** driver asleep-at-the-wheel
 - **8X** driver physical impairment (e.g., heart attack)
 - **6X** speeding
 - **10X** aggressive driving
 - **3X truck driver not wearing safety belt**



Questions?

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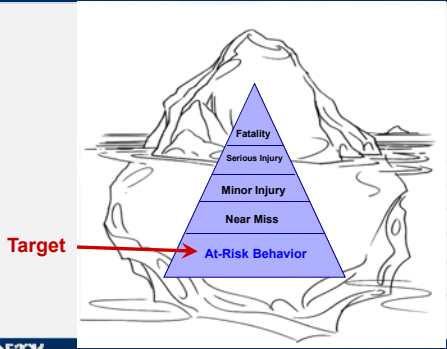



BEHAVIOR-BASED SAFETY (BBS)

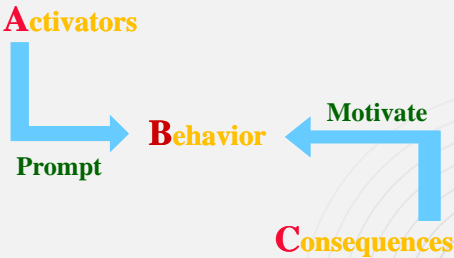

- Method for reducing workplace accidents and injuries
- **Proven effective: 62% average accident reduction**
- **Combines:**
 - Behavior modification
 - Quality management
 - Organization development
- **Focuses on changing behavior, not attitudes or outcomes**
- **Problem in implementing BBS in trucking:**
Most driving behavior not directly observable.



BBS GOAL: REDUCE AT-RISK BEHAVIORS





THE ABC MODEL FOR BEHAVIORAL SAFETY MANAGEMENT

TWO BEHAVIORAL PRINCIPLES

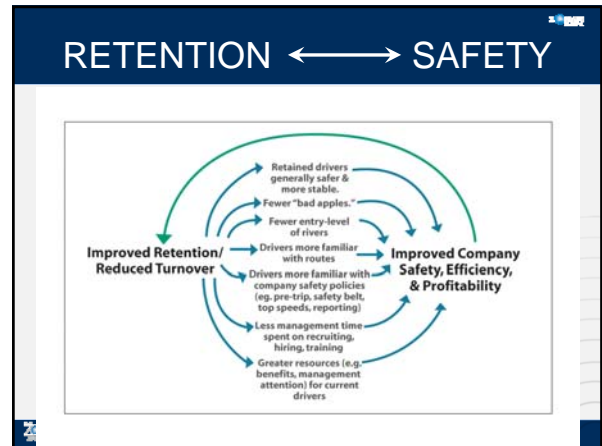
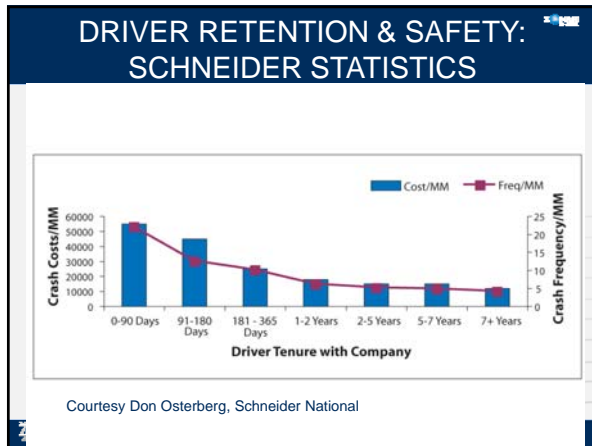
1. The Feedback Principle: *Feedback facilitates performance.*
2. The Law of Reward & Punishment: *Rewarded behaviors increase, punished behaviors decrease.*



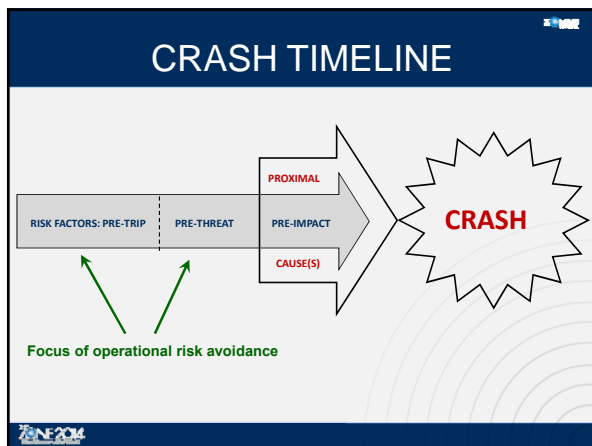
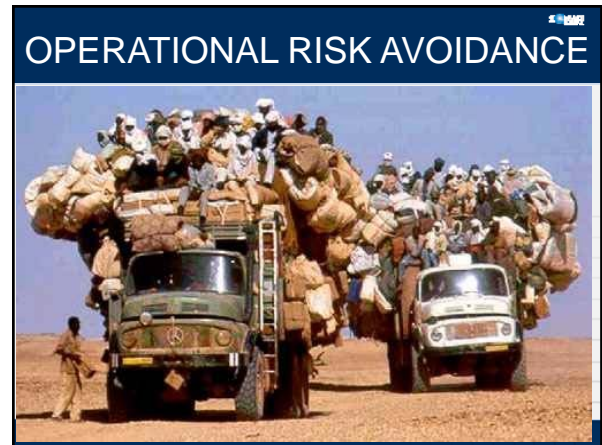

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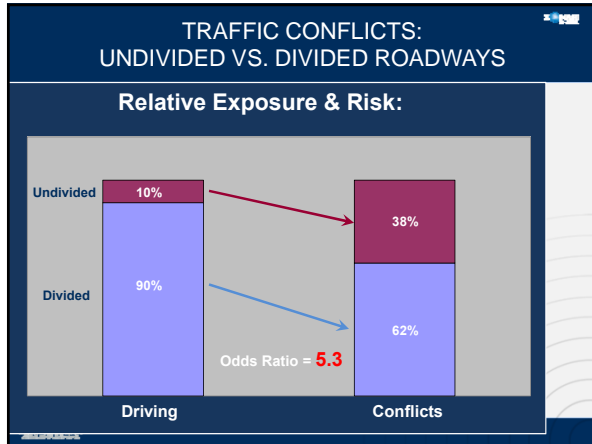
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TRAFFIC CONFLICTS: UNDIVIDED VS. DIVIDED ROADWAYS

Location:	Event Type:	% Traffic Conflicts	% of Driving
Undivided Road		38%	10%
Divided Highway		62%	90%

Odds Ratio: Undivided : Divided
 (38/10) : (62/90)
 3.8 : 0.69 = **5.3**
 (i.e., **5.3-fold risk on undivided roads**)



TRAFFIC CONFLICTS: BY TRAFFIC DENSITY

Traffic Density:	Event Type:	% Traffic Conflicts	% of Driving
Heavy		17%	3%
Medium or Light		83%	97%

Odds Ratio: Heavy : Medium or Light
(17/3) : (83/97)
5.6 : 0.86 = **5.9**
(i.e., **5.9-fold risk in heavy traffic**)

TRAFFIC CONFLICTS: WORK ZONES VS. NORMAL ROADS

Location:	Event Type:	% Traffic Conflicts	% of Driving
Work Zone		6.0%	0.8%
Normal Road		94.0%	99.2%

Odds Ratio: Work Zone : Normal Road
(6.0/0.8) : (94.0/99.2)
7.5 : 0.95 = **8.5**

In the LTCCS, 18% of truck at-fault multi-vehicle crashes occurred in work zones.

SPEED: ENEMY OR FRIEND OF SAFETY?

At-Fault Truck Crashes: Top 6 Critical Reasons in the LTCCS	% of At-Fault Crashes
Too fast for traffic conditions or curve/turn	21%
Inattention, including distraction and other recognition failures	17%
Inadequate surveillance – looked but did not see	12%
Vehicle or cargo problem (all included)	10%
Asleep-at-the-wheel	7%
Illegal maneuver	5%

- ### WHICH TRUCKS HAVE THE **LEAST** RISK?
- A. Trucks driving 85mph**
High risk because of greater stopping distance, possible loss-of-control, high crash severity, etc.
- B. Trucks driving 65mph**
Probably has least risk!!!
- C. Trucks driving 35mph**
High risk because truck is likely:
- On undivided road
 - In dense traffic
 - Around crossing traffic
 - On narrow or curvy road
 - In construction zone, etc.

TRAFFIC CONFLICTS: ≤50MPH VS. >50MPH

Speed:	Event Type:	% Traffic Conflicts	% of Driving
0-50 mph		63%	16%
51+ mph		37%	84%

Odds Ratio: 0-50mph : 51+ mph
(63/16) : (37/84)
3.9 : 0.44 = **8.9**
(i.e., **8.9-fold incident risk when vehicle traveling ≤50mph**)

The “Speed Paradox”

SPEED: ENEMY, & FRIEND!

Excessive speed for conditions is a top proximal cause of truck crashes, yet traveling at steady highway speeds (e.g., 65-mph) is the safest travel condition.

More generalized conclusion: Structuring operations to maximize efficient travel also maximizes safety.



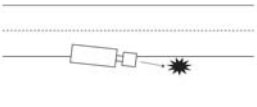

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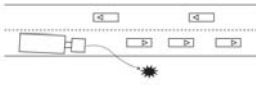


ROAD DEPARTURES & ROLLOVERS: GREATEST THREAT TO OUR DRIVERS

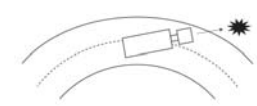
a) Drift off straight roadway



b) LDC following evasive action




c) Excessive speed on curve



LTCCS CRs:

- Too fast (21%)
- Asleep (19%)
- Vehicle failure (15%)
- Recognition failure (14%)
- Physical impairment (9%)



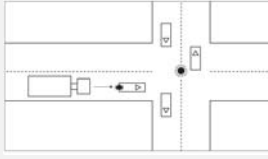
ELECTRONIC STABILITY CONTROL



May prevent 11% of all Truck-related fatalities!

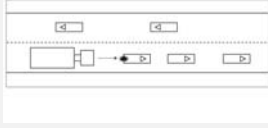


REAR-END CRASHES: GREATEST SOURCE OF CARRIER LIABILITY




Lead Vehicle Stopped:

- Recognition failures (31%)
- Degraded braking (19%)
- Physical impairment (10%)

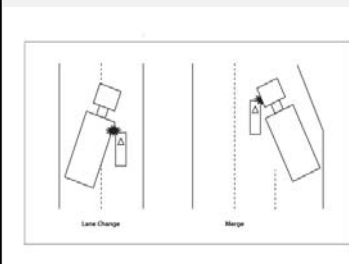


Lead Vehicle Moving:

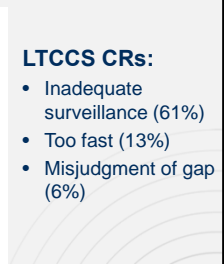
- Following too closely (33%)
- Too fast (25%)
- Recognition failures (20%)
- Other vehicle at-fault (16%)



LANE CHANGE/MERGE CRASHES: GREATEST TRUCK OVERINVOLVEMENT




Lane Change



Merge

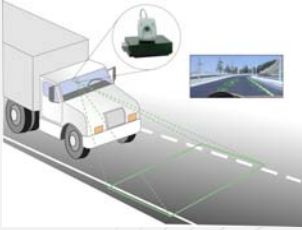
LTCCS CRs:

- Inadequate surveillance (61%)
- Too fast (13%)
- Misjudgment of gap (6%)

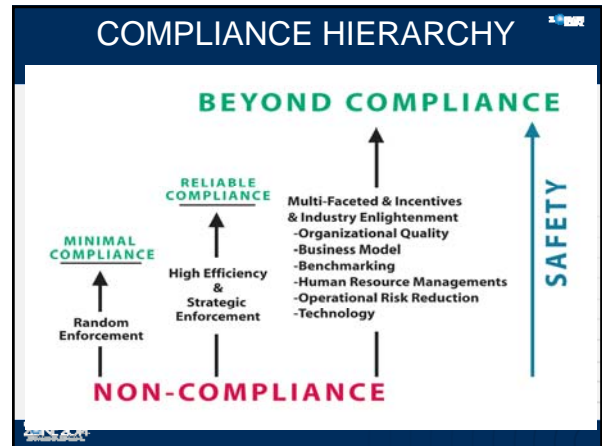


COUNTERMEASURES: COLLISION WARNING SYSTEMS

- Lane Departure Warning (Roadway Departures, Head-on)
- Forward Collision Warning (Rear-end)
- Side Object Detection Systems (Lane change/merge)



Courtesy Iteris, Inc.



Thanks for your attention!



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-- Safety Training & Management Support --